203a Homework 3, due Feb 8

1. Consider $\vec{A} = \widehat{z}(2I/c)\ln(r_0/r)$ in cylindrical coordinates, which is the vector potential for a wire carrying current I on the $\widehat{z}$ axis. An electron is ejected from $r = r_0$ with velocity $\vec{v} = v_0\widehat{r}$.
   (a) Write out L in cylindrical coordinates.
   (b) Find all conserved quantities.
   (c) Find the maximum value of r reached by the electron.

2. Jackson 12.3.

3. As discussed in Tom O'Neil's lecture notes and in Jackson section 12.5, for slowly varying fields the notion of adiabatic invariants are very useful. From classical mechanics, the generalized action integrals are $I = \frac{1}{2\pi}\oint pdq$. Evaluate $I = \frac{1}{2\pi}\oint p_\theta d\theta$ for the non-relativistic case $p_\theta = mr^2\dot{\theta} + \frac{q}{2c}B_0 r^2$, to show that $I = \frac{1}{2}mr_\perp^2\,\Omega_c = \frac{1}{2}mv_\perp^2/\Omega_c$, where $\Omega_c = eB/mc$.